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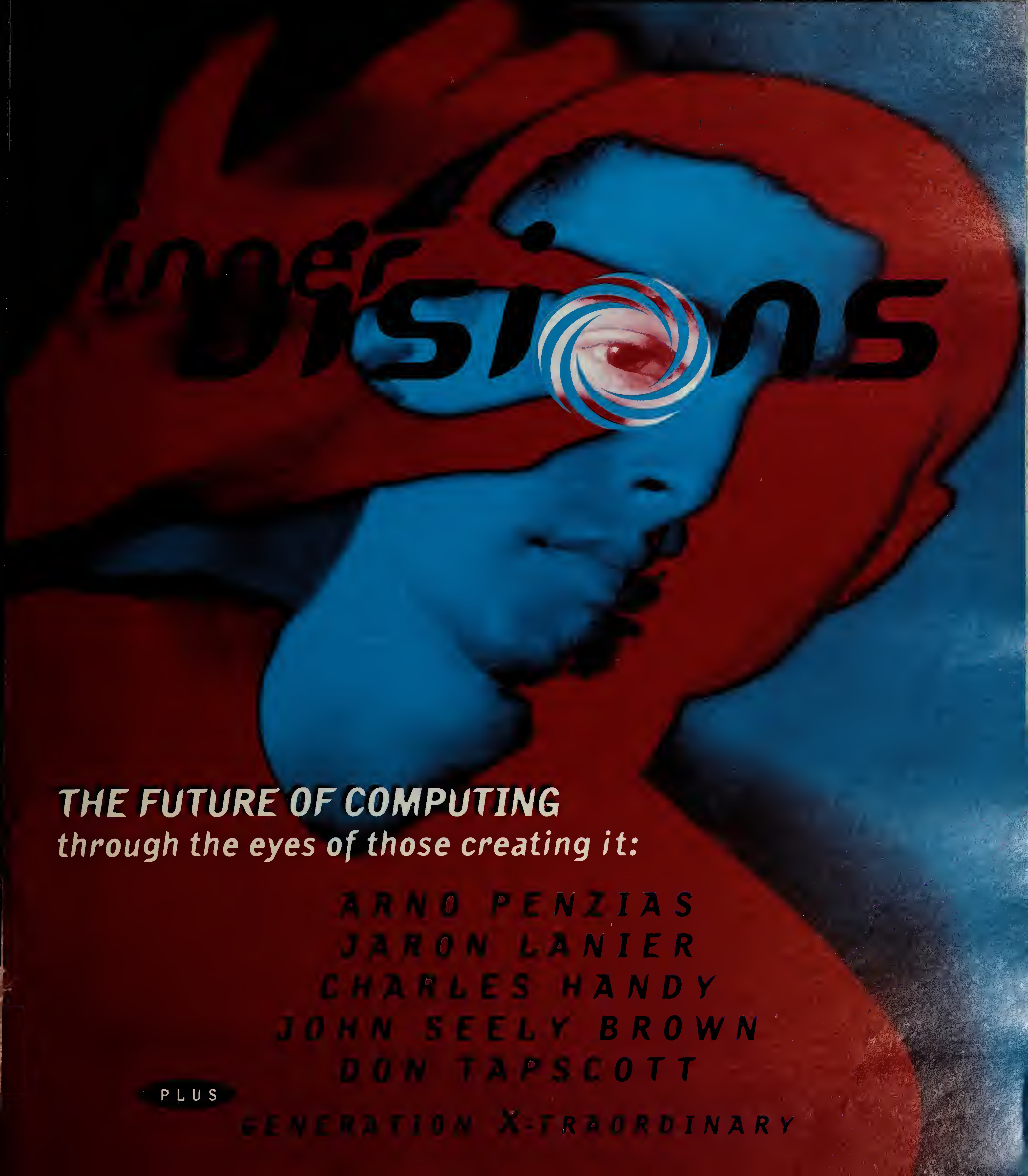

inner visions

THE FUTURE OF COMPUTING
through the eyes of those creating it:

ARNO PENZIAS
JARON LANIER
CHARLES HANDY
JOHN SEELY BROWN
DON TAPSCOTT

PLUS
GENERATION X-TRAORDINARY

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The Newsweekly for Information Technology Leaders

Welcome to *"The Future of Computing,"* a special supplement to Computerworld.

It's very fitting that on the occasion of their **20th anniversary** Computer Associates, along with its business partners, has chosen to sponsor this look into the future by a number of our industry's visionaries. Over the last two decades Computer Associates has consistently succeeded in delivering the vision of Charles Wang and the other forward looking individuals who built the company into a world leader.

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inner Visions

s/2 ARNO PENZIAS

Collision Ahead

by Bill Laberis

"You can extrapolate any technology to the 14th decimal point, and you still won't get the answer to the future. What you have to discover is what the technology is going to collide with," says Bell Labs' Nobel prize-winning chief scientist. Want to know how the Internet explosion happened? Penzias explains this and predicts the next *big bang.*

s/6 JARON LANIER

Hand in Glove

by Glenn Rifkin

He didn't *predict* the virtual reality field, he *fathered* it – at the tender age of 24. He also saw millions of dollars flow into – and out of – his hands. Now 12 years older and wiser, this self-made Renaissance man foresees a world of virtual cities by 2025, where well-paid, high-tech "bicycle messengers" will navigate massive, complex databases for the rest of us.

s/9 CHARLES HANDY

British Umpire

by Ron Condon and Bill Laberis

He may hold court on the other side of the Atlantic, but Britain's preeminent management "thinker" could trade visions of the future with both Thomas Jefferson and Adam Smith. Instead, he's trading his views on business federalism, corporate efficiency and outsourcing with chief executives from around the world.

s/11 JOHN SEELY BROWN

Of Mice and Zen

by Alice LaPlante

"Business process re-engineering is backfiring," says the esteemed director of Xerox PARC. "Attempts to put mission-critical applications on client/server architecture are turning out to be little more than automating the sales force." CIOs are not to blame, Brown says, but they *are* in a position to transform and save their companies in the next decade. He points to some unusual places for the answers.

s/16 GENERATION X-TRAORDINARY

Roundtable

by Joseph Maglitta

Companies that want to harvest prizes from the current crop of twentysomething superachievers may have to exchange desks for poolside lounge chairs. This handful of technology-savvy hotshots doesn't hesitate to forecast the technology winners and losers for the 21st century.

s/19 DON TAPSCOTT

Economics 0001 0000 0001

by Brian S. McWilliams

The man anointed "the world's leading cyber-guru" by Vice President Al Gore predicts half the human population will be on the Internet by 2025, and its impact on our lives will surpass all previous revolutions in human communication. But don't get smug. The 'net has nearly as much potential to destroy existing businesses as it does to create new ones, Tapscott warns. The future will be kind to CIOs who understand the digital economy and cruel to those who do not.

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inside

"Punch a hole in the sky."

That's what test pilot Chuck Yeager was told just before a mission-critical flight in his supersonic jet in the movie *The Right Stuff.* Go where no human has gone. Let in new light. Show us the future.

So it is with humankind. We are obsessed with the future, that obsession being a peculiar mixture of anticipation, curiosity and dread. Thus, we put our faith in the hands of a very small number of people to show us the light shining from that far-off dimension we call tomorrow.

We asked a group of futurists to punch a hole in the sky and give us a glimpse into the future of computing and information management.

The composite image derived from their individual visions is a daunting one, to say the least. If there is one overarching piece of advice they impart, it is this: Don't hang on too dearly to the world you have come to know, because it is going to change dramatically from the inside out.

For one thing, information management in the enterprise will move once and for all beyond the role of "cost reducer" and into the forefront of business strategy. That's right. Information management will not only enable new and daring businesses but, correctly used, will be at the vanguard of shaping business strategy. That's the way author and business futurist Don Tapscott sees life in IS unfolding in the next 10 years.

John Seely Brown, the unconventional head of Xerox PARC, and Jaron Lanier, the *very* unconventional father of virtual reality, claim business will look far afield to disciplines like music, anthropology and linguistics in setting the course for IS to follow in the next century.

Arno Penzias, whose research confirmed the big bang theory of the universe, foresees collisions of near-galactic proportions overtaking the world of IT and profoundly altering your world. And from his favored perches outside London and in Tuscany, organizational seer Charles Handy takes the enterprise leagues beyond its quarter-to-quarter gyrations to a brave new world of true individual empowerment — aided and abetted by the information network.

You'll also hear from a group of five young men destined for IT leadership. How will their idealism be reconciled with the cold, hard reality of tomorrow's dawn?

Peer inside these pages. The bright light within emanates from that hole punched in the great beyond by our visionaries.

Bill Laberis
Project Manager

Within a decade, says Arno Penzias, there will be millions of cable modems in operation, and we'll be talking to our refrigerators.

Whether it's the universe
or the Internet,
the world as we know it is
shaped by things that
go **BANG!** *in the dark.*
Predicting the collisions—
now that's the hard part.

arno PENZIAS

collision ahead

by Bill Laberis

The Internet is the single most significant phenomenon in computing history. More is written about 'net-related subjects than about any other aspect of information technology. Yet, what is today an all-consuming passion for many was just three years ago confined largely to academic and research ghettos. No one predicted its near-term impact. No one.

"That's because you can extrapolate any technology to the 14th decimal point, and you still won't get the answer to the future," says Arno Penzias, chief scientist at AT&T's Bell Laboratories in Murray Hill, N.J. "What you have to discover is what the individual thing, like a technology, is going to collide with. You have to figure out what's going to bump into what. Then, maybe you've got something."

The Internet? By itself, a boring network. It was around for 20 years before the Mosaic browser appeared.

Then, it banged into something else, namely "all that great middleware that allowed ordinary humans to make searches without having a detailed knowledge of each of the parts of the 'net," Penzias says. "What gives the Internet impact is not part of the Internet at all, but a different technology it ran into: The use of object-oriented programming. It was an unexpected combination."

Collisions. Resultant explosions. The dust settles. Something new, often unpredictable, is born. Much like the universe, itself the result of an unfathomable explosion or "big bang" that Penzias was able to prove actually happened, earning him a Nobel prize in 1978. So it's small surprise that Penzias' visions of the future are shaped by theories about technologies banging almost randomly into each other, giving rise to new advances.

Penzias' earliest memories are those of a Polish refugee, whose family fled from the result of the greatest and most catastrophic collision in human history, World War II. He can wax philosophical, almost poetic, about technology, lifelong education and vacations he is planning with his fiancee. But strike a nerve, like government cuts in research funding, and out pops the occasional unprintable expletive. At 63, Penzias is the product of cultural collisions and, thus, remains a little Europe, a little Brooklyn.

His two decades' experience as the head of vaunted Bell Labs would further cement his thesis that great leaps in technology occur not when individual technologies are birthed but when two or more technologies collide.

AT BELL LABS 30 YEARS AGO, ARNO PENZIAS TRIED TO CLEAN UP SOME FUZZY RADIO SIGNALS HE WAS MEASURING FROM ANOTHER GALAXY. HE COULDN'T. BUT FROM THAT FRUSTRATION HE DEVISED WHAT WOULD BE A NOBEL PRIZE-WINNING THEORY: THE DIRTY NOISE WAS RADIATION LEFT OVER FROM THE "BIG BANG" — THE COSMIC EXPLOSION THAT CREATED THE UNIVERSE. AT&T THEN DID THE RIGHT THING AND MADE PENZIAS THE HEAD OF BELL LABS. TODAY, AS BELL'S CHIEF SCIENTIST, HE THINKS, TRAVELS, LECTURES AND WRITES BOOKS. COLLISION THEORY STILL DOMINATES HIS VIEWS OF TOMORROW.

"You can extrapolate any technology to the 14th decimal point, and you still won't get the answer to the future. What you have to discover is what the technology is going to collide with. Then, maybe you've got something."

Penzias observes that many collisions occur, but few produce anything lasting or substantial. The reason? Few products of collisions "work with" other things, he explains, which is the real measure of these collisions, and the real measure of anything. The collision of the 'net and object-oriented programming worked with advances in data communications, sharp declines in PC hardware costs and storage prices, and the demands of universal data access.

Warning! Next Collision Due

Does Penzias see any new measurable collisions out there? He certainly does. It's going to be a big one, too. You know all those silly info appliances that are cropping up? Things like smart phones, network computers, TV set top boxes — even the home PC. By themselves, Penzias notes with apologies to Gertrude Stein, "there's not much 'there' there."

However, these techno-geek and hobbyist items just happen to be on a collision course with what Penzias calls the "negative cost of networking." The result? A huge new industry that he labels "home orchestration." And if you don't think there are broad implications here for IS professionals, think again.

But first, a word of explanation about Penzias' curious "negative network" costs. "It will simply cost more to make stand-alone things than to make networked things," he says. The stand-alone items each require mechanical interfaces, storage, backup, some means for updating and so on. All such requirements, he says, will disappear when products are networked from the start.

New ways to shop

So perhaps the network costs aren't literally negative, but there will be great potential economies realized when these various info appliances are networked to each other. Industries will be born, and some will boom. Others will be transformed.

Like what?

"Take home shopping, which today is a toy. You call someone and basically ask them to have someone else push a shopping cart down the aisle," Penzias says. "But when you have a million customers instead of a few thousand, then you design a new supermarket with heavy automation to do the picking up for you, like a factory. Then, when you have 30 or 40 customers on a block, you can afford to go back to the old milkman thing with an inexpensive delivery route."

More specifically, within 10 years, most refrigerators will include an optical reader on the door, as well as a microphone, Penzias says. Polish off the last gulp of milk, zip the container's bar-coded label past the infrared reader and say "buy two more" into the mike. That information goes via the new home network to the home PC, which adds it to your shopping list and phones in the order. Thus, the collision of negative networking with info appliances totally changes a commodity shopping market — the back end of which must be totally overhauled by IS to accommodate these changes.

All within 10 years.

What about the network outside the home, the one connecting all those appliances to the outside world? What medium will transport the home orchestration market?

Here, Penzias is on home turf — data communications — and he is very confident. "There will be direct broadcast satellite, affordable, too. Fiber links will be brought in by new providers. Fixed wireless of many different kinds. T1 lines cost a lot today, but they won't tomorrow. And the cable companies aren't going away," he maintains. "You'll use them all, or in some combination.

"Everyone I know is producing cable modems," he continues. "Ten years out, sooner I am sure, there will be millions of [cable modems] in operation. There will be a multiplicity of communications devices and of communications vendors and a host of new communications clients, all brought to you by the negative cost of networking bumping into these information appliances."

What about asynchronous transfer mode (ATM), the data transport medium about which Penzias said just a few years ago "a solid consensus is building"? Well, sometimes things go bump in the night, and sometimes they don't. ATM today is no longer a big deal to Penzias. There are other, more significant, collisions going on, like that of frame relay and the products of the white-hot switching vendors.

Today, and probably through the end of the decade, IS will connect its networks with fast Ethernet or with frame relay, he says. "I'm less interested in ATM today because people have worked around it. They will continue layering the net connectivity problem with more technology. The important thing is that these big frame-relay networks are throwing billions of bits around the country, and people who have them are happy.

"As a phone guy," he says, "I didn't give enough credit to the computer side of things. So instead of throwing communications technology at the problem, users and vendors like Cisco Systems, Inc. will throw computing technology. Works just fine, too."

Changes in store for IS

So the negative cost of networking will spur entirely new markets — home orchestration being one — while giving massive boosts to others. IS, meantime, will find itself wrestling with the monumental task of retrofitting existing systems and networks to accommodate the change wrought by these seemingly random collisions. What will happen to the IS organization itself?

Penzias agrees, to a point, with the observation of New York-based The Research Board that centralization and the proliferation of network technology go hand in hand. In the next few years, he says, companies will begin to seriously address the hidden costs of computing. These costs are embodied in data from the consulting firm Gartner Group, Inc. in Stamford, Conn., which pegs the five-year cost of owning a single networked PC at about $45,000.

Controlling runaway costs will require standardization — that is, central IS control over critical elements of the IS infrastructure.

"To take advantage of the negative cost of networking, you will have to make sure everyone is using the same version of the apps," Penzias asserts. "And, dare I say it, you can use the network to ..." Penzias halts, as if trying to clear a bone from his throat. "You can use the net in the future to set standards for the behavior of employees, to normalize their activities. I think maybe 'control' is a strong word, but you get the idea. You must guide the behavior of people. The network will allow you to do that."

And how will such attempts to normalize business behavior (for example, to ensure workers aren't 'net surfing when they should be working) square with the upcoming generation of workers, those current teenagers who are reviled by the thought of anyone curbing their cyber activities?

The future in this regard is no different from the past, Penzias says. Certain kinds of jobs with certain work rules will attract certain kinds of people. "Some employees won't tolerate certain things, others will," he says.

Ultimately, for Penzias, what people will or will not do, what of significance will or will not happen, comes down to math and chance and random collisions.

ISDN, he notes, has been talked about more than any other technology that has yet to happen. Penzias has had an ISDN line in his New Jersey apartment for five months and still can't get it running.

"There are no standards. And if you try to do an extrapolation of when something like ISDN would become a standard, you'd get the wrong answer, which we did with ISDN," he says. It just hasn't had the benefit of a good, hard collision yet. And maybe it never will.

Editor in chief of *Computerworld* for 10 years, LABERIS is now principal of Bill Laberis Associates, a custom publishing and media consulting firm based in Holliston, Mass.

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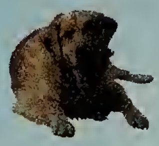

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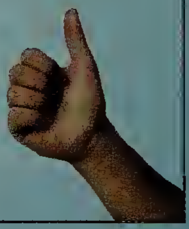

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The **Boy Wonder** of virtual reality sees a world of virtual cities where well-paid, high-tech "bicycle messengers" will navigate a grid of massive, complex databases for end users and execs alike.

by Glenn Rifkin

jaron LANIER

Jaron Lanier, who practically invented virtual reality, admits his efforts to commercialize the technology were premature. In fact, its time is still to come, he says.

IN 1984, AT THE TENDER AGE OF 24, JARON LANIER WAS THE COVER BOY FOR *SCIENTIFIC AMERICAN*, IN A VIRTUAL SENSE. MORE SPECIFICALLY, THE COVER STORY FOCUSED ON A PECULIAR PROGRAMMING LANGUAGE CALLED EMBRACE, A HIEROGLYPHIC TONGUE THAT WOULD BECOME THE LINGUA FRANCA FOR THE WORLD OF VIRTUAL COMPUTING. THE HIGH SCHOOL DROPOUT FROM NEW MEXICO PARLAYED HIS LANGUAGE CREATION INTO VPL RESEARCH, INC., THE FIRST COMMERCIAL VENTURE TO EXPLOIT VIRTUAL REALITY. BUT EVEN HIS FORTUNE WOULD BE VIRTUAL. HE MADE AND LOST "TENS OF MILLIONS," BY HIS RECKONING, WITH NONE OF IT FLOWING THROUGH HIS HANDS.
LANIER, THROUGH IT ALL, REMAINS THE CONSUMMATE VISIONARY.

In the steamy 1994 film *Disclosure*, starring Michael Douglas and Demi Moore, virtual reality made a cameo appearance in the techno-thriller's pivotal scene. Douglas' character, searching for crucial information to save his career, enters a corporate database using virtual reality goggles, glove and a 3-D representation of a file cabinet in which the sensitive data is stored. Buoyed by special effects, the virtual world is stylishly eerie, ominously futuristic.

"I viewed it as a validation of our concept," says Jaron Lanier, the visionary who tried to commercialize virtual reality in the 1980s. "Usually, you take a movie about technology and have to add a sex scene to keep the audience in place. Here, you had a movie about sex and you had to add a virtual reality scene to keep the audience interested."

In truth, Lanier says, the movie's vision was "preposterous." He says users are too sophisticated to want virtual reality representations of file cabinets. The assumption that users want only electronic versions of familiar things, such as file cabinets and Rolodexes, is wrong, Lanier insists. Virtual reality's whole reason for being is to take advantage of new ways of visualizing complex data. "Users want tools that take maximum advantage of their cognitive abilities," Lanier says.

Jaron Lanier. A man of voracious appetites. Physically imposing, with Medusa-like, waist-length red dreadlocks cascading over a spreading girth, he doesn't so much contemplate a universe of concepts and philosophical theories as ingest them whole. Eyeing the future as a gastronomic smorgasbord of possibilities, Lanier takes big bites and savors each one.

In fact, by the year 2025, Lanier foresees massive, complex databases of the future as virtual cities — 3-D visual representations with neighborhoods that a programmer or database operator will get to know in the same way they get to know the place where they live. The cities will be very quirky, Lanier explains, not with superclean lines like cities in sci-fi films, but with different textures, sensibilities and even smells, like real cities.

Making sense of complexity

Right now, he says, cities are our best example of group learning of very complicated things. Even long removed from a particular city, someone returning will quickly recall places and ways to get around, despite the complexities and amount of detail required. As a database — not the simplified sci-fi view of *Disclosure*, but in the real world — data flow, control flow, dependency and other relationships between objects would be represented as streets. The city would be somewhat flat, but not two-dimensional. There would be levels of underpasses. Bird's-eye views are possible, and each part of the city would be ornamented with specific sights, sounds, textures and smells to assist in recalling large numbers of neighborhoods.

Naturally, within such an environment, the roles of information technology professionals would have to change dramatically. Lanier predicts a significant restructuring of the IT profession with new job titles and new capabilities. "Employment in the future, particularly in this field, will be the equivalent of what artificial intelligence can't do," he says.

So far, AI can do very little, and Lanier doesn't expect that to change radically any time soon. But if it does, he says, so will employment. Many current job descriptions will vanish, and a new class of AI oversight positions will open up. "If AI got very good, even those jobs would vanish, leaving no job open for humans but that of stockbroker or manual laborer," Lanier says with a laugh.

In these supercomplex databases, made viable by virtual reality interfaces, there will be a cadre of people whose talent is running through the virtual cities and finding information. Lanier equates this profession with "bicycle messengers" in today's cities. "Their job will be to act as translators between the way people on the outside world remember the data and the way it is represented in the city/database," he suggests.

Lanier resists the notion that virtual reality will enable end users to act as their own bicycle messengers in these cities. Douglas' character in *Disclosure*, for example, couldn't possibly have negotiated such complex databases so easily. The cities will be too complex for any visitor to traverse easily and quickly, thus opening the door for specialists whose deep knowledge of a particular database will keep them in demand.

"The complexity will be such that there won't be just one virtual city that holds all the world's databases. There will be many, many different cities," he predicts.

But a generation of bicycle messengers? Lanier quickly points out that this is just one layer of IT. In other areas, Lanier predicts less dramatic change. Software in the future, he says, will continue to be "messy enough that we can always count on a well-paid layer of people dealing with the problems of integrating legacy systems. That's probably the safest employment bet for the next millennium."

Surprisingly, the 36-year-old Lanier, whose name became synonymous with virtual reality in the early 1980s, currently is removed from the often frustrating attempts to commercialize virtual reality — a technology, he says, whose time is still to come. The rendering hardware simply wasn't robust or cheap enough to give birth to the market. "It still isn't," Lanier adds.

Since childhood, the iconoclastic Lanier has floated contentedly at the edges of the mainstream, eyeing the potential of computers with the seasoned wisdom of a visionary far beyond his years. A high school dropout who later took college courses in mathematics and computer science, he is passionate about technology's impact on society, on democracy, on the economy.

Just recently, for example, Lanier began working with a German humanitarian group that is building computer systems to help de-mine areas infested with anti-personnel land mines. He is thinking about how to use virtual reality techniques to help visualize sensor fusion problems in detecting the mines.

"They've been programmed to evade detection by people like us, the people who went to computer science school," Lanier says. "In order to really clear an area, technology is needed." Lanier's work involves using virtual reality to combine information from different mine sensors into a heads-up display to help de-miners find their quarry with greater efficiency.

Passionate about his lifelong crusade to transform programming from an esoteric art form for a select priesthood into a vernacular craft for the masses, Lanier insists programming techniques must, and will, change radically in the 21st century.

"Right now, we're essentially using a software development paradigm from the Fortran era," he says with amazement. Lanier believes there are two complementary approaches that can be applied to creating a better user interface and software development methods. The first is to improve the machine representation of complexity to create better tools for analysis and manipulation. The second is visualization, which improves the user interface so that the user can understand, remember and manipulate complex structures more easily. That is where virtual reality comes in.

No magic bullet

But the change will be very gradual, "maybe not even in my lifetime," Lanier says. "This is a genuinely hard problem. Different solutions will emerge and succeed or fail in varying degrees. There will be no single magic bullet, no headline that screams 'Today Software Got Easy.' "

Thus, the current generation of IT professionals won't experience enormous change, Lanier says. Revolutionary change won't occur for the simple reason that the consensus weight of IT as it stands today will prevent massive shifts from happening.

Gradually, though, the profile of IT professionals who design internal databases and networked corporate systems will begin to resemble the young people of today who are designing corporate Web sites; people who combine traditional IT skills with a creative bent.

But, again, such change will be slow. With the brittle nature of software, he warns, the IT profession must, by its very nature, be conservative. "So I don't expect these changes to happen overnight," Lanier states. "They are not going to happen on the clock of new technologies, which would be very fast, but rather on the clock of human generations, which is rather slow."

> **Software in the future will continue to be "*messy enough* that we can always count on a well-paid layer of people dealing with the problems of integrating legacy systems. That's probably the safest employment bet for the next millennium."**

Lanier also envisions a dichotomy for chief executive officers and their relationship to the IT world, a relationship currently strained at best. On the one hand, he says, virtual reality systems should allow the CEO to better understand the potential of technology — "when you can see better, you can reach farther" — but, conversely, because increased visualization will lead to greater complexity, "the CEO might end up right back where he or she was before."

Instead, Lanier predicts a "Holy Trinity" corporate environment in which the CEO, CFO and CIO own equal layers of activity and each will be perceived as running the company "in a different cosmic plane."

For Lanier, the idea of virtual reality was based not on *Star Trek*-like images of the future but on the clearheaded vision of a superb computer scientist. Early on, he saw the potential of visualizing large, complex databases in three dimensions as a superior form of programming and remembering. It was a way, he theorized, to help users comprehend the "irreducible complexity" of large computer systems. Lanier believes that learning keyed to an environment — especially an environment in which one perceives one's body to be moving, such as in a corridor or on a street — is more effective for comprehending complex and abstract associations.

Lanier, in fact, can't seem to get enough complexity. "Give me more complexity," he yells, laughing. To that end, Lanier spends his time composing and performing what he calls "new classical music," along with writing, painting, teaching and even making movies. His first music CD, *Instruments of Change*, features Lanier playing dozens of exotic instruments from around the world along with the more conventional piano. He is a visiting scholar at both Columbia University, in its computer science department, and at New York University's Tisch School of the Arts.

Having created wider and wider circles within which to ply his various avocations and stretch his visions, Lanier is as content as anyone in the area of high tech.

"For our particular civilization, technology is our adventure, our frontier, our Wild West," he says. "We just love these new adventures, getting jostled and pushed by it."

photo by Dirk Westphal

RIFKIN is a freelance journalist based in Concord, Mass., who writes about technology.

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His vision of the enterprise playing field of tomorrow is a montage of Jefferson and Marx, overlaid with lots of Adam Smith. **Get ready for a new ball game.**

charles HANDY

BRITISH UMPIRE

by Ron Condon and Bill Laberis

Wake up to a field of dreams or to a scene of "devastation." It's your choice, says Charles Handy.

photo by Elizabeth Handy

It would be easy to dismiss Charles Handy's view of the future of the business enterprise as being Utopian or quasi-Marxist or even just plain nuts. In a day when corporations around the world are lopping off employees like scythers mowing a hay field, it is hard to envision a time 10 years out or so when both senior and junior employees will act as a voting block on major business issues such as "cost-containment re-engineering." That's a euphemism for mass layoffs.

But the heads of some of the world's biggest companies don't think Handy is nuts at all. In fact, they devour his books — which they must do as a prerequisite to meeting with him. They must also meet him at his home outside London before he'll see them on their turf. And they do, quite willingly, thank you.

Then, after listening to this apostle of business federalism, the chief executives of international behemoths go home and ponder just how they will approach their boards with Handy's unorthodox ideas about organizations. Because he touches them deeply, he probably frightens them, at a level no one else can.

"It's either a major rethink about the new types of work and property and all their implications, or it's waking up in the morning to a scene of devastation," Handy says. We're already getting a peek at this devastation, he says, in the form of knowledge workers and their managers who are either burned out or utterly lacking in the values that used to bind them to the old paternalistic companies of yesterday.

For IS, Handy's views hold forth a world of possibilities at a time when the IS profession is under siege in many quarters. Witness the continuing and increasing turnover of CIOs at U.S. companies, as evidenced by the recent annual survey of top information executives by Cambridge, Mass.-based CSC Index, Inc.

The world, according to Britain's answer to management guru Peter Drucker, is about to experience a decades-long "economic earthquake," which will forever topple all the old centralized, machine-age ways of doing things.

Replacing these companies that today are driven by short-term, often quarter-to-quarter financial statements, Handy says, will be companies run on a federalist model. Is Handy an apostle of Thomas Jefferson, too? Perhaps. In Handy's federal model, a small, central-core organization — headquarters — monitors the performance of highly autonomous business units. IT not only will provide the vehicle for speeding information out to the business units and, thence, to the knowledge workers, but will itself also be organized as a federation with a centralized core. Core IT may establish and enforce standards, but most of IT's functionality will be concentrated heavily in the outlying units.

Instead of devaluing workers, Handy insists, the successful and, therefore, the only surviving 21st-century companies — the federalists — will be those that grant more power to the real assets of the company — its workers. That includes giving senior, and even some junior, employees a voting voice in corporate strategizing. If you think the Marxist in Handy is beginning to show, keep listening. Part of Handy's vision of the next century sounds like capitalism with a capital C.

Organizations must continue to be ruthless in their search for efficiency if they want to survive, he says. Specifically, companies must halve their staffs every five years, paying the remaining half twice as much to be three times more productive. "It's a harsh but inescapable calculation," Handy claims.

Great deal for the half that gets its pay doubled. But what happens to the corporate castoffs? That's what's nice about Utopia. There's a place for everyone. The surplus staff becomes the core of 50% of the working population who, Handy says, by the year 2000 will be working outside the traditional organization. Doing what? Why, handling the increasing load of chores outsourced by the company.

These outsourced chores should not include mission-critical IS, though, he is quick to add. Handy says IS plays a pivotal role in the 21st-century corporation. "The information architecture is the nervous system of this new organizational model, and so the design and functions need to be finely tuned to allow the business to run smoothly," he maintains.

Which is precisely why Handy stands in steadfast opposition to the wholesale outsourcing of IT or critical elements of it. The 21st-century corporation will outsource those activities "that do not give the company a competitive edge," he says. "One of the few things that pulls [the corporation of tomorrow] together is the information and communications system."

Thus, information is a key competence that must stay firmly at home, within the company. "In my view, it is crazy to outsource IT," Handy declares. "Why give the design of the information architecture to someone else? They can't possibly know the organization as well as you do."

CHARLES HANDY'S BEST-SELLER *THE EMPTY RAINCOAT* LEVELED A BLAST AT THE DEHUMANIZING IMPACT OF THE '90s CORPORATION AND ITS TENDENCY TO REDUCE WORKERS TO THE STATUS OF REPLACEABLE PARTS. THE AUTHOR OF EIGHT OTHER BOOKS AND A FOUNDER OF LONDON BUSINESS SCHOOL LEFT A LUCRATIVE CAREER IN BUSINESS DECADES AGO TO BECOME "JUST A THINKER," WHO TODAY IS COVETED AS A CONSULTANT BY THE TOP BRASS AT THE BIGGEST OF COMPANIES. HIS IDEAS ARE RADICAL, EVEN FRIGHTENING, BUT ULTIMATELY HUMANISTIC.

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john seely BROWN

What the heck does a bunch of **philosophers, musicians, artists** and **linguists** have to do with the future of information management? Apparently plenty, if you believe the brain trust that gave us the mouse, the GUI and much more.

Of Mice and Zen

by Alice LaPlante

Xerox Corp.'s Palo Alto Research Center (PARC) has long offered one of the clearest windows into the future of computing. And many point to PARC Director John Seely Brown as the most astute interpreter of the view from that vantage.

Within PARC's terraced white buildings, researchers have created such landmark technologies as the mouse, the graphical user interface and the Ethernet network topology. But today, Brown's vision of the future is not being shaped by computer scientists alone. Oh, they're here, but they're in a talented pool of 300 degree-laden individuals that also includes physicists, philosophers, linguists, sociologists, psychologists — even musicians and artists. "Our true breakthroughs seem to come in the white spaces between fields, when we put people together who have quite different points of view," Brown says. (See story, s/14.)

Ask Brown about the most exciting developments under way at PARC, and you'll hear less talk of network bandwidth than of corporate "communities of practice" and "social fabrics." Indeed, emerging technologies seem to interest Brown primarily in how they will influence and be influenced by social processes, within both commercial enterprises and the world at large.

AS DIRECTOR OF ONE OF THE MOST INNOVATIVE AND SUCCESSFUL INFORMATION RESEARCH LABS IN THE WORLD, JOHN SEELY BROWN IS MORE INTERESTED THESE DAYS IN HOW ARTISTS MAKE CREATIVE LEAPS AND HOW PEOPLE ACQUIRE KNOWLEDGE THAN HE IS IN THE LATEST ADVANCES IN PURE TECHNOLOGY. IT'S NOT THAT HE'S DISINTERESTED IN TECHNOLOGY. QUITE THE CONTRARY. AFTER SIX YEARS LEADING THE VENERABLE PALO ALTO RESEARCH CENTER, BROWN NOW BELIEVES THAT INTEGRATING VISIONS OF THE FUTURE OF INFORMATION TECHNOLOGY WITH DISCIPLINES SUCH AS ANTHROPOLOGY AND MUSIC PAINTS THE BEST VIEW OF IT IN THE 21ST CENTURY.

The coffeepot is your friend. Encourage, don't squash "unauthorized" learning, says John Seely Brown.

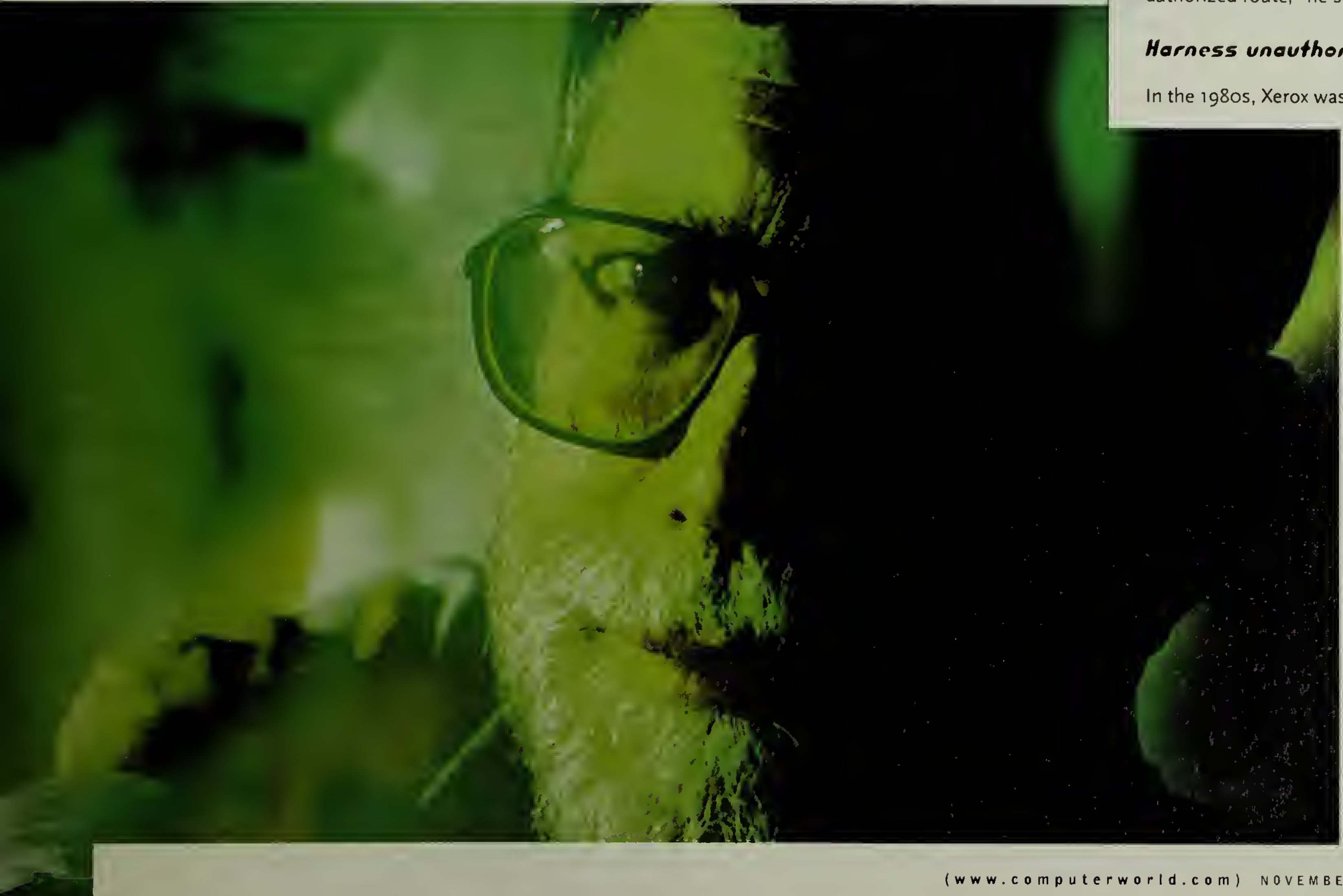

photo by Evan Pilchik

Using the synergy that arises between the various members of PARC's eclectic community, Brown is sketching a future in which the very nature of work will undergo radical transformation — as will traditional notions of IS management, about which Brown is decidedly unenthusiastic.

"Business process re-engineering is backfiring," Brown says. "Attempts to put mission-critical applications on client/server architecture are turning out to be little more than automating the sales force."

This is hardly the fault of technology managers alone. Still, Brown believes CIOs are in a position to initiate the massive organizational changes that must take place in the next five to 10 years for companies to remain competitive.

Ultimately, this means CIOs will need to understand social and technical requirements, as well as "figure out how to make workers effective, rather than simply productive," Brown says.

For starters, Brown points out that corporate life has both authorized and unauthorized aspects. For example, all work that gets done within the boundaries of the classic organizational chart, using any formal processes set up within lines of business or departments, can be classified as authorized. But much of the work in any viable operating business, Brown says, is actually accomplished in unauthorized ways — that is, by employees transcending formal processes and organizational boundaries to collaborate unofficially on solving problems. "Not incidentally, such employees are usually more effective than if they followed the authorized route," he says.

Harness unauthorized learning

In the 1980s, Xerox was spending millions of dollars on training for its field technical representatives — the employees who repair equipment at customer sites — by bringing them back to headquarters and putting them through formal classes. In an attempt to boost productivity, Brown hired anthropologists to study how these employees actually did their jobs.

It turned out that the real learning took place in the field offices, as reps came in from their assignments and traded war stories around the coffeepot. This "unauthorized" training — which would have been dismissed as dead time in a traditional business re-engineering study — was in fact where real value for Xerox was being created, in terms of disseminating creative solutions to customer problems.

It is in cases like this that collaborative technologies, such as those found on the Internet, the World Wide Web and corporate intranets, hold the most promise, Brown says. Indeed, he sees the competitive landscape of the future absolutely requiring corporations to recognize the importance of unauthorized work. Furthermore, he envisions CIOs in five to 10 years as being instrumental in facilitating the natural exchange of ideas — and the off-the-charts creativity — so essential to a dynamic and successful business.

Companies that do not encourage this type of exchange will be at a serious disadvantage, Brown warns.

"There is something wonderfully ad hoc about the Web that lets you do incredible things on the cheap — and sometimes even on the sly — that promises to deliver very good things," Brown says.

PARC is studying how to make the best use of Internet technologies through internal use of MUDs. Originally called Multi-User Dungeons — the first MUD was an online version of the fantasy game Dungeons and Dragons — these are increasingly referred to as Multi-User Dimensions or Multi-User Dialogues, as they evolve into business communication tools.

A MUD is a virtual space where people can meet electronically, even though they are physically dispersed. Two things distinguish a MUD from a chat area on an online service such as America Online or from a linear E-mail exchange: the interactions between participants are simultaneous and take place in real time; and the work space, although virtual, has characteristics that endure even if current participants leave the so-called space.

Early MUDs consisted primarily of text exchanges between participants. But that is changing to include other mediums. At Xerox, software developers can enter these virtual conference rooms via their networked computers; open video windows that allow them to see and hear others in the room; put documents on a virtual conference table; or scribble on a virtual whiteboard that everyone in the room can view or annotate.

Because these virtual workplaces blur the boundaries between the physical and virtual, and because they are unencumbered by organizational or geographic boundaries, they "allow the workers to create intellectual and practical communities spontaneously that truly support the daily work that must get done," Brown says. This kind of interaction will be necessary, he suggests, if corporations want to encourage and reap the benefits of truly collaborative work in the future.

Brown has written about these so-called "communities of practice" at National Semiconductor Corp., where a group of engineers unofficially began conducting reviews of new chip designs. Word spread throughout the company that this group could provide extraordinarily valuable — albeit unauthorized — advice to other design teams. The net result? The weaving of unauthorized work into existing structures to make a new social fabric supporting quality improvement.

And this never would have happened if employees had stuck to approved processes.

Brown points to one technology in particular that promises to make communities of practice viable. Internet Multicast, also called Mbone, allows continuous simultaneous connections between multiple computers (unlike current Internet/intranet implementations, which provide brief links between two computers at one time). Mbone — invented by PARC researcher Steve Deering while he was a graduate student at Stanford University — will vastly cut the costs of sustaining these multiple connections, making possible real-time audio and videoconferencing between distributed sites.

"This is a huge idea, one that will have tremendous implications for the corporate IT climate 10 years out," Brown says. But here's the challenge associated with all of the technologies mentioned: Can IS, which often has trouble supporting even the most structured business activities, provide the right kind of technological direction to enable these social changes?

According to Brown, only if the CIO seizes more responsibility.

CIO holds key to future

Brown sees CIOs assuming responsibility for the enterprise information architecture. Putting the right kind of technology infrastructure in place is only the beginning. "Corporate quality efforts, human resource activities and corporate training will all coalesce within the office of an information architect" — or, as Brown likes to call the CIO, "the learning architect."

"With today's accelerated pace of competitive change," Brown says, "a corporation's real edge comes from being able to adapt swiftly to fluctuating market and economic conditions and, therefore, from being the fastest at learning. Technologists are in the best position to take a leadership role here, but, by and large, most IS shops don't realize this yet."

To succeed, a CIO must ask fundamental questions that go beyond technology, power politics and turf wars to discover where true value is being created, Brown says. If the value is being created at the coffeepot, the CIO must make sure the organization not only captures this value, but keeps it percolating.

LAPLANTE is a freelance journalist based in Woodside, Calif.

Between Art and Science:

Fringe Benefits

If you're trying to invent the technological future, whom do you hire? If you're John Seely Brown, director of Xerox Corp.'s Palo Alto Research Center (PARC), you look toward the fringe. The artistic fringe, that is.

In 1993, Brown established the PARC Artists in Residence (PAIR) program, which offers generous cash stipends to painters, photographers, writers and other artists who compete for a handful of prestigious, 12-month residencies on the PARC campus in California.

Brown's idea is this: Bring in artists who are already pushing the creative and technical boundaries of their disciplines. Act as matchmaker by coupling each artist with a PARC scientific researcher with whom they seem to find creative synergy. Give them the run of the place for a year, then see what happens.

"In many ways, artists are trained to push boundaries, to extend the limits of existing genres," Brown says. How is this relevant to PARC? In a multitude of ways, but specifically when exploring the commercial possibilities of the World Wide Web and the Internet, Brown says.

Basically, the Web represents a new document type. "On the Web, all there are are documents. There's nothing else," Brown says. "So this funny little theme we have of Xerox as the document company plays very well with what's happening in cyberspace."

This is also where artists come in, by helping to rethink traditional definitions of what a document can be. For example, one PAIR project is studying how to turn a video clip into a Web document. It's not as simple as it sounds, Brown insists. PARC isn't interested in simply allowing people to view a video, or even to download it or capture still shots from it. Instead, PARC wants to be able to exploit all the possibilities of emerging Web technologies to create "a new document type altogether," he says.

This might include highlighting the most interesting parts of the video. Or allowing users to manipulate or edit the video. Or developing multiple indexing structures so that viewers can search through the various aspects of the mediums — the images, the soundtrack or the text of the screenplay — and see how they interact. In short, viewing a Web video document would be a completely different experience than playing a video on a VCR.

The PAIR program has been so successful in exploring these types of issues that Brown created a new laboratory in March that extends the concept.

Called the Creative Documents Initiative, it is run by an artist and former director of the PAIR program, Rich Gold. The project has the parallel goal of bringing artists and researchers together, but focuses specifically on creating and managing documents that contain multiple mediums.

– Alice LaPlante

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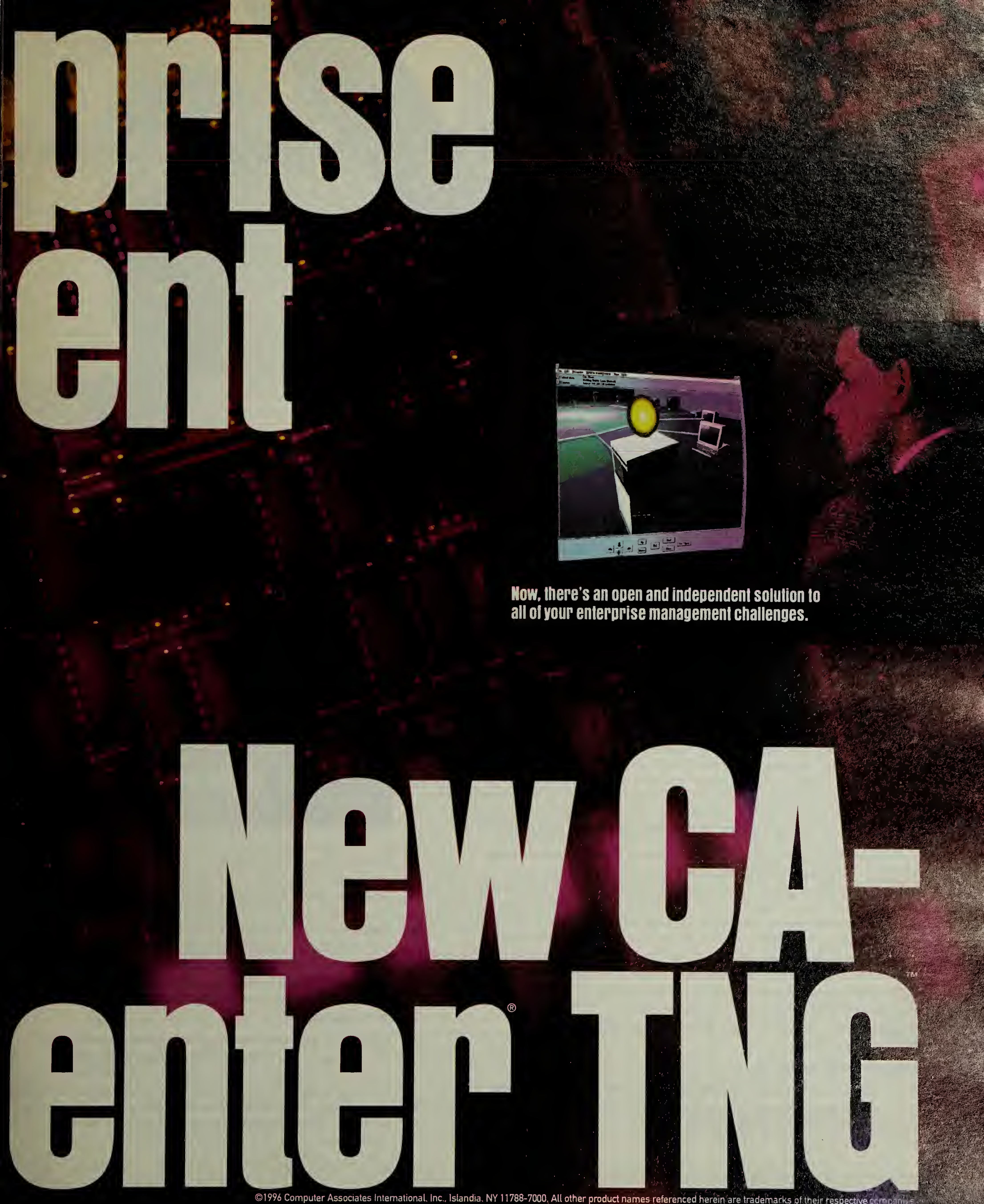

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Ready for Zazen meditation,
poolside computing, work you like
and "wetware"?
Five twentysomething standouts are.
Unfortunately, you probably
won't meet them in
the halls of corporate IS.

by Joseph Maglitta

Thank God for Netscape, Yahoo and every other company juiced by twentysomethings for reminding Wall Street — and the rest of us — that the technology savvy of Generation Xers extends well beyond Sony Playstations, TV remote controls hunting Brady Bunch *reruns and computerized cash registers for their crummy slacker jobs at McDonald's.*

Sit a few minutes on a sunny afternoon with Tait Stevens, Bobby Land, Dykki Settle, Bruce Padmore and Steve Crutchfield, and you're quickly reminded that before Bill Gates, Steve Jobs and Scott McNealy were 40, they were 20.

Computerworld *recently scoured the country for bright young achievers who are shaping the next generation of computing. They may or may not follow in famous footsteps, but they've already had an impact. (See bios, facing page.) These newcomers are smart, articulate, philosophical and idealistic, but pragmatic. They care about the poor, the disabled, the uneducated and other technology have-nots, but believe in free markets. None is older than 24. Here are highlights from a recent videoconference in which we asked the group to talk about the future of work and technology.*

Q: In the future, do you think corporate IT will be able to attract young people like yourselves?

DYKKI: The world of the corporate IS department is a maintainer culture, where people are more concerned with 99.99% stability and sticking with what works. My culture is an innovator culture, where 80% stability is good enough, and there is always a new problem around the corner. I see many innovators who have trapped themselves in maintainer cultures, and vice versa, and they are invariably unhappy. No way would I be foolish enough to put myself where I could do more harm than good and be unhappy to boot.

BOBBY: It would depend on the corporation. I'd like to be on the cutting edge of the Internet, working with new hardware. I really don't want to be stuck behind a desk with few options to explore.

TAIT: If the focal point of my job were prototyping or implementing new technology, yes. If it were simply maintaining off-the-shelf stuff, I'd just be working for money.

STEVE: I'd rather be the guy that designs the car than the mechanic.

BRUCE: I'd run screaming.

PARENTS' WORK ATTITUDES

Q: How does your attitude toward work in general contrast, say, with your parents' attitudes?

BOBBY: My parents saw work as a 9-to-5 deal. I see work that is stored on a disk and finished at night in the den or at the side of the pool watching the kids on the weekend. I don't like the way my parents view technology as something difficult.

TAIT: They seem to like [their jobs] OK, but they are on a time clock and production oriented. Their jobs are not outgrowths of their hobbies. I like an environment where deadlines are set because they are *actual* deadlines, not because they want to see what you are going to get done. I need a boss who can cope with the idea that 9-to-5 might not be my most productive hours.

BRUCE: In the past, work followed a defined routine to complete a familiar task on a daily basis. In the future, more work will involve developing solutions to new or changing needs which are completely unfamiliar.

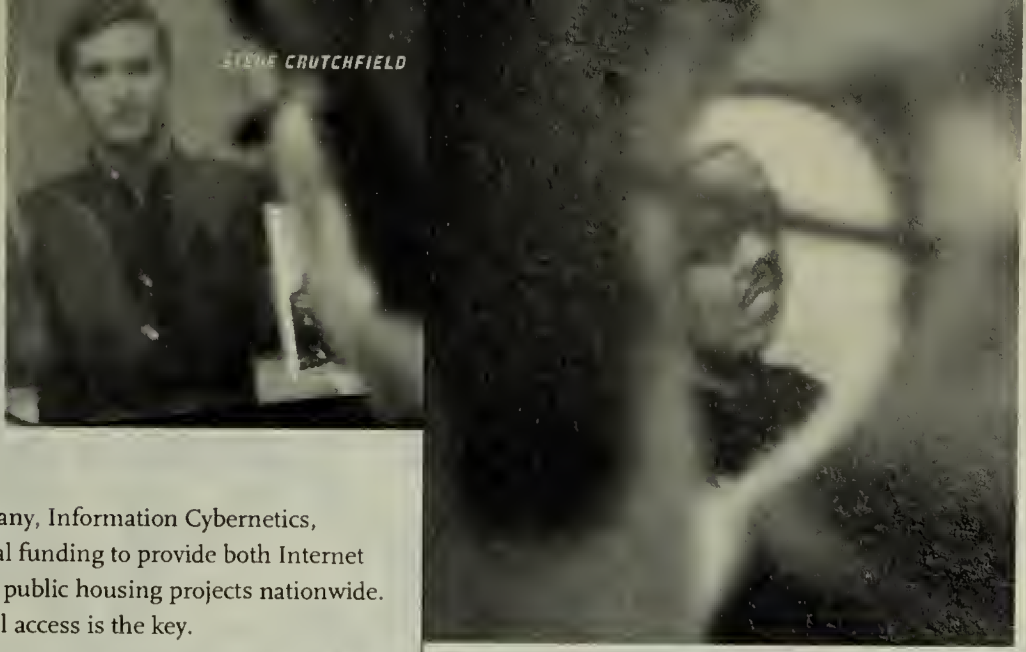
DYKKI: If your job forces you to distinguish clearly between work and non-work, then you are doing the wrong kind of work.

TECH KEEPERS

Q: Within that future work environment, which technologies look promising?

TAIT: Intelligent agents. Intelligent agents. Intelligent agents. Intranets are going to take off incredibly. Net computers, I think, are going to happen. But not just for [getting to] the Internet. What if users could bring in their own modules to upgrade the net computer for the day? Beginning users could use the standard "VW Bug" configuration, but experts could bring in their upgraded modules and use the "Ferrari."

"Our children will see new methods of understanding and manipulating biological systems... Ever had to debug a cow?"



photos by Craig MacCormack

BRUCE: Personalization tools that gather information about the user and edit — or filter — data that is sent to the user. Also, automatic response technology, which allows analysis and classification of free-form incoming information and determines the correct action to take based on that information.

BOBBY: Voice recognition.

DYKKI: Our children will see new methods of understanding and manipulating biological systems. This biotech, or "wetware," will be an entirely new world of interfacing technology and life, bringing its own opportunities and problems. Ever had to debug a cow? Tools operating on the atomic and subatomic levels [will] allow the development of computers, machines and matter manipulation at submicroscopic levels.

STEVE: I see computers headed for the same fate as those tiny motors we have all over our homes and offices — in fans, hairdryers and CD players. We don't think of them as motors; we think of them according to their function. That's what people really want from technology — little things that they can interact with directly to organize their appointments, sort out their finances, ideally linked by some sort of network. Special-purpose solutions, not monolithic $5,000 behemoths that do everything.

SILICON BUGGY WHIPS

Q: Which technologies are destined to become buggy whips over the next five to 10 years?

DYKKI: Gopher. NetWare and Lotus Notes. CD-ROM is doomed, as well as silicon chips.

BOBBY: Anything that exists now can be integrated into a new environment.

Q: In this room are five males, four of them white. We looked hard. So where are the standout women and other minorities?

STEVE: A very good friend of mine, a woman majoring in computer science, has told me that at times she's heard things amounting to "it's a man's field" from peers and even professors. The only real solutions are long-term solutions, and I think it all gets down to elementary [school] education.

BOBBY: There is no female Bill Gates. We need a woman saying, "Look at me. I did it, and so can you."

BRUCE: Without an abundance of female and minority role models as technologists, there is still a sense of futility to overcome. When I was growing up in New Orleans, a lot of people didn't see how technology applied to their lives. They were really surprised when I showed them. My mother sacrificed and gave me whatever books, software and electronic devices I wanted — no questions asked. I found my ideas and solutions were just as good, if not better, than my peers'. I said, "I can play this game." But I'm a mutant.

TAIT: Just wait.

Q: Are we destined to become a society of technology haves and have-nots?

BRUCE: My mother told me when I was young: "If you have money, you can make money." At first I did not understand that odd remark, but as I grew up, it made itself bitterly clear. I had no resources to go to. I had to teach myself. My company's parent company, Information Cybernetics, is working to gain federal funding to provide both Internet access and hardware for public housing projects nationwide. We believe that universal access is the key.

TAIT: Improvement of our educational system will help allow the have-nots to become haves. It's very poor thinking to say, "if we put computers in schools, that is going to solve all the problems."

BOBBY: As time passes, prices will go down, allowing more people to buy the computer or get the Internet connection. Competition is the key to the have and have-not situation.

STEVE: Think of television when it first came on the scene 50 years ago. All the neighbors would crowd around the only set on the block. Today, you see TVs at restaurants and gas stations, and many people have several at home. So as a technology matures and its price falls, availability increases and, perhaps more importantly, awareness of the technology and how to use it increases. Twenty years ago you had to be able to program to use a computer. With today's graphical user interfaces, you don't even have to type.

DYKKI: I see clear deterioration of the middle class over the next couple of decades. What can be done? I don't know yet. ... I am experimenting with community "information brokers," enabling the rural and low-income *community* rather than the individual. I think that may well be a first step.

Many times, I have felt that it is white, liberal, digerati ignorance, egocentrism and foolishness to believe that this is something that other cultures even *want*. But then I forget about such nonsense and keep butting my head against the wall.

TAKE OFF BLINDERS

Q: Complete this sentence: The technology of tomorrow could be improved by incorporating more influence from ...

DYKKI: Alternative cultural reality constructs. Zazen meditation, aikido-based flow dynamics, aboriginal dreamtime, Navaho neurolinguistic programming, etc. We have been terribly egocentric in our Western European, Protestant, work-ethic technology philosophy. A little peppering of alternative cultural paradigms would significantly advance the global community and the human condition.

STEVE: People outside the technology industry. People in the industry become very self-satisfied and complacent. So many of these companies think they are changing the world and creating revolutionary new products, but when these products hit the market, they just don't fit people's needs.

What we need to do, both in academics and in industry, is to think about what kind of technology would help the vast majority of people out there who know nothing about computers — the thinkers, artists, craftsmen, poets. It's obvious that the greatest potential for the industry to expand lies among that vast majority of people who don't actively use computers. They're where the future is. ◆

DYKKI SETTLE, 24. Vice president, Ventana Technology, Carrboro, N.C. First graduate in reality engineering from University of North Carolina. Key role in developing first public World Wide Web server and HTML standard. In 1994, co-founded DreamTech Enterprises with wife, Shannon. DreamTech produced the first trade publication on the Web — *Umney's Last Case* by Stephen King. Settle's teams have been creating new Internet and multimedia technologies.

TAIT STEVENS, 22. This Fall started MD/Ph.D. fellowship in medicine and medical information technologies at Loma Linda University in Riverside, Calif. Developed custom software and systems for Riverside General Hospital, University of California, Riverside, March of Dimes, Medical Office Services, Inc. Produced technical illustrations for *International Journal of Bifurcation and Chaos*. Currently working on transmitting real-time patient information over TCP/IP. Also developing a nonprofit Internet telecommunications firm.

STEVE CRUTCHFIELD, 19. Junior at Johns Hopkins University in Baltimore, majoring in electrical/computer engineering and computer science. Original software includes Zoom Lens for the visually impaired and Beam Wars, a shareware arcade game. Teaches grad students programming. Finished his second internship at Apple Computer, Inc. this summer.

BOBBY LAND, 19. Biology and computer science double-major at Marist College, Poughkeepsie, N.Y. Webmaster for school's World Wide Web academic site, developed two French and Russian sites. Also developing school's first electronic admissions application. His prototype electronic athletic hall of fame is expected to be funded soon by a major corporation.

BRUCE PADMORE, 24. Director of information technology at Cambridge, Mass.-based Millennium Productions, Inc., a firm merging art and technology. Bachelor's degree in mechanical engineering from Massachusetts Institute of Technology. Worked at IBM's Thomas J. Watson Research Center in New York. Left after realizing he was allowing "technical pursuits to define his thinking" rather than vice versa. Invented Braille mouse.

MAGLITTA is senior editor, corporate strategies, at *Computerworld*. Special thanks to PictureTel Corp., Danvers, Mass., which handled the logistics, technical work, and provided the venues and connections for our four-site videoconference roundtable.

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A SCORE OF TOP-FLIGHT IT VENDORS AND LARGE-SCALE USERS HAVE HIRED DON TAPSCOTT TO HEAD UP THE ALLIANCE FOR CONVERGING TECHNOLOGY, A MULTIMILLION-DOLLAR STUDY OF HOW COMPANIES CAN TRANSITION TO THE DIGITAL ECONOMY. WHY NOT? HE WROTE THE BOOK ON IT, WHICH FOLLOWED ANOTHER BEST-SELLER, *PARADIGM SHIFT*. TO TAPSCOTT — CONSULTANT, AUTHOR AND THE MOST SOUGHT-AFTER IT SPEAKER ON THE RUBBER CHICKEN CIRCUIT TODAY — DIGITAL NETWORKS LINKING NOT MACHINES BUT HUMAN INTELLIGENCE WILL HAVE A MORE PROFOUND EFFECT ON HUMANKIND THAN DID THE PRINTING PRESS. HYPERBOLE? READ ON.

by Brian S. McWilliams

photos by Eduard Gajdel

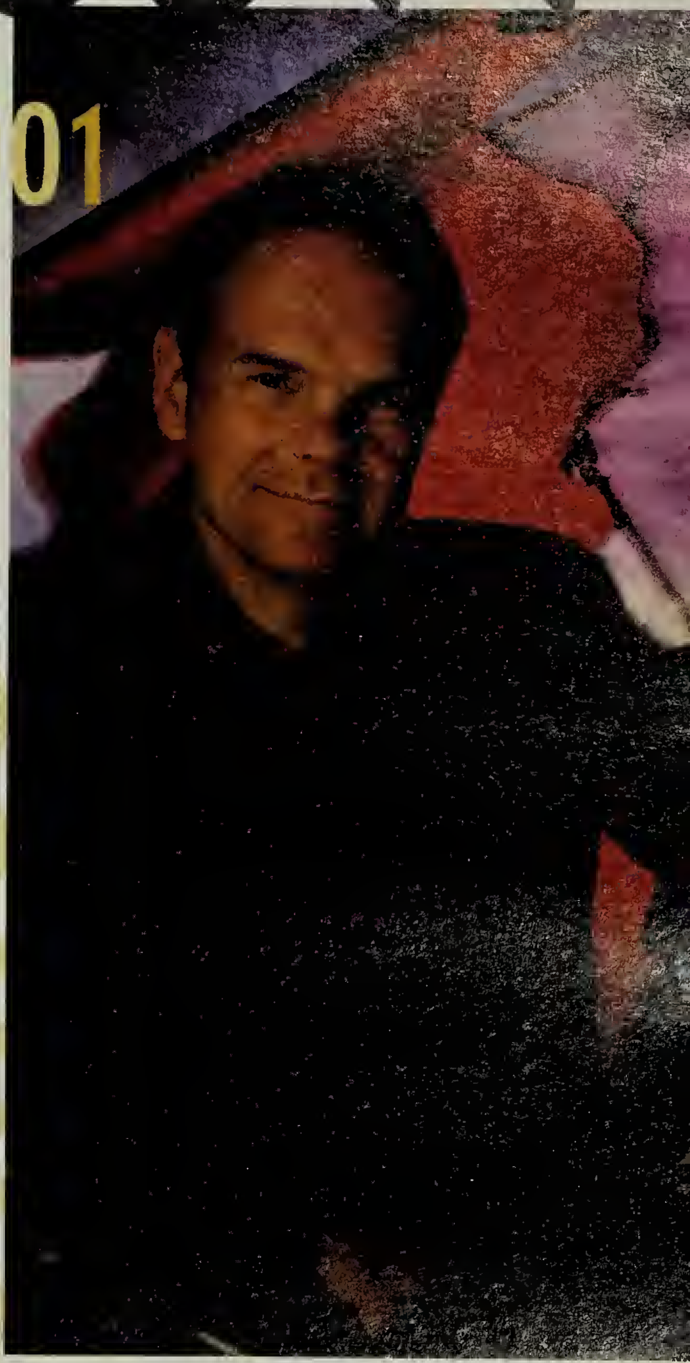
Fifty minutes into his recitation on how the Internet in the foreseeable future will transform computing and business, Don Tapscott hits a serious downdraft. Held aloft by talk of convergence and networked intelligence, it's as though he's been riding a thermal above this century-old, three-story brick building where his consulting company, New Paradigm Learning Corp., has its offices in a restored section of downtown Toronto.

Pressed on how this emerging digital economy will affect children, suddenly, the man anointed "the world's leading cyber-guru" by no less than U.S. Vice President Al Gore plummets swiftly earthward.

"I know the 'net will make the world smaller for them," he says softly, speaking of his son, 9, and daughter, 13. Both, like their dad, are avid users of the Internet and online services. "But I'm not sure if it will make the world any better."

Tapscott can turn on the hyperbole as well as any author of best-selling business books. But it's this groundedness, this ability to describe both the Internet's opportunities and hazards in a way that has both economic and personal urgency, that differentiates him as a visionary from many Cassandras of computing. It's also what's made Tapscott a trusted counsel to corporate information executives and other business and government leaders.

Hewlett-Packard Co., MCI Communications Corp. and Xerox Corp. have hired him to head up The Alliance for Converging Technology, a multimillion-dollar study of how companies can transition to the digital economy.



The future will be kind to CIOs who understand the digital economy. But woe to those who do not, warns Don Tapscott.

Tapscott predicts that by the year 2025, half the human population — more than 4 billion people — will be on the Internet, compared with today's 30 million users. That's not all. He expects the 'net to surpass all previous revolutions in human communication — the printing press, telephone, television, even the computer — in its impact on our economic and social life.

Even if you don't buy that scenario, it's difficult to disagree with his claim that the 'net has the potential to destroy old businesses nearly as quickly as it is creating new ones. "We are on the verge of a fundamental change in the nature and role of information technology," he says. "Finally, IT is coming into the heart of the enterprise. It will no longer simply be about avoiding costs. It will become the means by which individuals and enterprises create wealth."

For corporate IS organizations, the implications of the new digital economy are clear, Tapscott says. Don't stop at aligning IT with business strategy; look for ways that IT can *shape* strategy. In this age of networked intelligence, IT will move front and center in a range of industries, from publishing and entertainment to health care.

Tapscott's favorite case study of the promise and peril of this new business model is Encyclopaedia Britannica, Inc. The best-selling encyclopedia for more than 200 years, Britannica suddenly slipped to No. 3 in 1994, as parents eschewed the 20-volume book set for the CD-ROM-based encyclopedias from Microsoft Corp. and Grolier Electronic Publishing that come bundled with many home PCs.

Concluding that it couldn't compete in the low-margin CD-ROM market, the company adroitly created Britannica Online on the Web and began licensing the service to universities rather than selling strictly to families. "In the process of transforming itself into an internetworked business," Tapscott says, "Britannica had to change no less than its product, distribution channels and customers. The only other choice was to become toast."

The future need not be perilous for companies that can adapt quickly and become "internetworked" — that is, use interactive multimedia and the Internet to transform how they produce and market products and services, as well as transforming the structure and goals of the enterprise. The first step is to recognize that, in the future, the physical flow of information, such as checks, bills of lading and face-to-face meetings, will be supplanted by digital information flow.

"Business models, not just business processes, must be transformed for the digital economy. The future will be kind to CIOs who understand the enabling effect of this new medium," he says.

But don't confuse this shift with the unfulfilled promise of the paperless office from technologies such as imaging, Tapscott says. "The effect of digitization goes beyond just speeding up communication. It will enable whole new ways of human collaboration," he says, pointing to the "paperless" design process the Boeing Co. adopted for its Model 777 aircraft as an example.

Far-flung, cross-functional teams designed and debugged the new aircraft, relying on networked workstations running 3-D computer-aided design and finite element analysis software. Among the benefits: The plane they created needed about 90% less scrap and rework than previous ones designed with paper-based methods, translating into significant cost savings and quicker time to market.

Just as physical communication will give way to digital forms, a company's physical assets will be less important than its intellectual riches in the future, according to Tapscott. "You don't look at a company like Netscape Communications Corp. and ask how many buildings they own, or what their cost of labor is, or even how much capital they have. Brain, not brawn, will enable companies to thrive in the new economy." He predicts the digital economy will level the playing field somewhat to allow smaller companies to make bigger, faster gains.

A high-stakes game

For most organizations, the impact of the digital economy will be felt more slowly than in the rapidly converging publishing, telecommunications and computing industries. Still, Tapscott believes the Internet stakes are too high for firms to justify a wait-and-see attitude toward developing at least a presence on the World Wide Web. Laggards, he says, should take no comfort in recent predictions by Framingham, Mass.-based market research firm International Data Corp. that many Fortune 500 home pages will close this year, resulting in ghost sites.

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"The only thing that's going to die," Tapscott hisses, "is the first generation of 'brochureware' applications. But they will be replaced by a second generation, like Britannica's, that fundamentally changes the business model."

Over the next 10 years, in Tapscott's view, information executives will be measured by their contribution to IT-intensive business initiatives — such as innovative, money-making Web applications — not by how well they enable their organizations to avoid costs. Enlightened companies will call on them to answer questions such as, "Given this technology shift, what products and services should we be creating for our customers?"

Besides bringing networked business opportunities to the table, IS executives increasingly will own the "important but dangerous" job of integrators and guardians of the corporate internetwork, he says. Slowing them down is what Tapscott calls "The Barbecue Law of the Internet: It ought to come with a sticker that says, 'Assembly required. Some parts not included.' " Even more than the paradigm shift to client/server, this rise of internetworking will require CIOs to learn a whole new set of technical skills, from Sun Microsystems, Inc.'s Java programming language and other virtual machine technologies to methods for implementing secure transactions over public networks. They must also manage an even larger and aggravatingly amorphous set of vendors.

Tapscott predicts the 'net will cause a shakeout of general-purpose hardware companies and encourage the rise of small, special-function hardware and software firms, as multimedia creates new product and service categories such as hybrid TV/computers, sensor systems and network-based entertainment and education.

Working in favor of network architects is the ratification of TCP/IP as computing's lingua franca. "Open systems are dead. Long live open systems," says Tapscott, who believes the main goals of open systems — interoperability and portability — will be achieved before the end of the decade. "As the saying goes, on the 'net, nobody knows you are a dog ... or a Mac or an OS/2 workstation or anything else," he says.

With plug-and-play networking and convergence will come the rise of what Tapscott calls "exonets." The flip side of the current craze surrounding intranets, which use HTTP and other protocols for internal applications, exonets will let companies tap into the publicly available network infrastructure. He compares it to the shift at the turn of the century when companies stopped generating their own electricity and bought it from public utilities. "We'll be able to shut down a lot of what we've been doing internally and exploit a public infrastructure.

"Say you need to do electronic data interchange with another company. Instead of hooking your company's network with your partner's and writing your own EDI system, the application will be available on the Internet from a third party like MCI Telecommunications Corp. or Ameritech Corp. — or even Walt Disney Co."

Though Tapscott predicts companies that cling to old business models will be history, his vision of computing's future is ultimately optimistic. The old hierarchical, centralized, one-way model of computing and communication is giving way to a new interactive and decentralized mode. "We're not just talking about an age of smart machines," he says, "but of people becoming smarter collectively through networking."

The future's dark side

Yet Tapscott is no Pollyanna. He concedes that the transition to a digital economy won't come without violent shifts in work and society. Employees will need to be retrained for the new world, just as they were in the shift from an agricultural to an industrial society. "When people get laid off in the foundry in Nashville," he says, "they can't just walk into a job at the Northern Telecom plant. They'll need a community college degree first. I'm not sure we've thought through these things."

Tapscott also worries that Internet use, limited by economic and technical barriers, may be far less than universal. The result, he says, will be "increased bipolarization of wealth, segregation of people into 'net haves and have-nots, and the creation of gated communities in cyberspace."

So the question remains: Will this new digital world be better, or just smaller? Tapscott defers, saying the future is to be achieved, not predicted.

"There's no technological imperative, nothing inherent in the technology that will ensure we realize the opportunities or the dark side. It's people that design systems of privacy, governance and work," he says. Tapscott challenges IT managers to bring their sense of social responsibility and values — as well as their technical know-how — to bear in shaping the digital future.

"That," he says, "is the only way we can ensure this era of networked intelligence will be an age of promise fulfilled and peril unrequited."

McWILLIAMS is a freelance journalist based in Durham, N.H.

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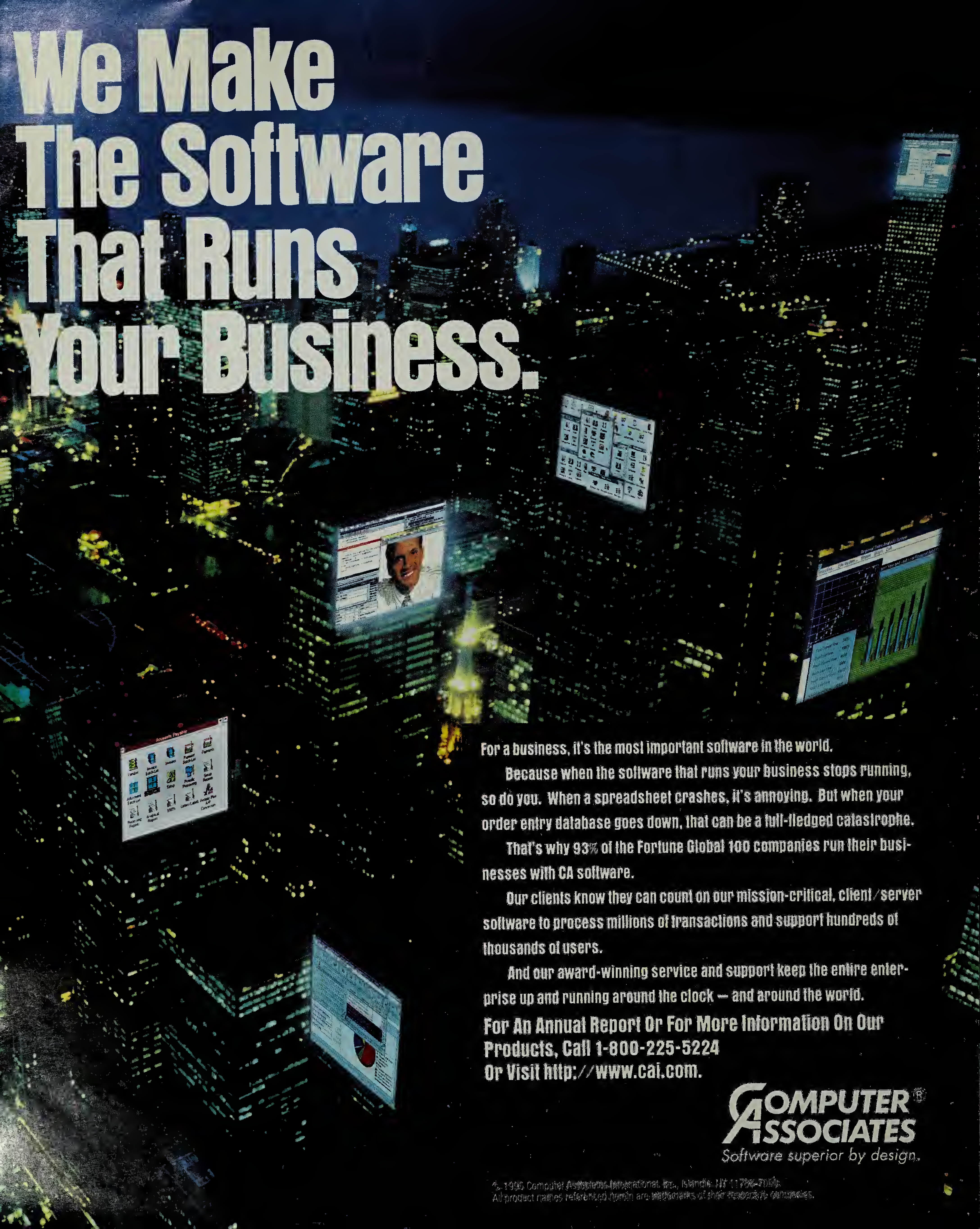

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